opSens

MultiSens

User Manual

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The end user shall not copy, disassemble or reverse compile the software program.

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WARNINGS

WARNING: HIGH PRESSURE!

High pressure gases and liquids are potentially hazardous. Energy stored in these gases or liquids can be released suddenly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been trained in proper safety practices.

WARNING : HIGH STRAIN!

Highly strained materials and parts are potentially hazardous. Energy stored in these materials or parts can be released suddenly and with extreme force. Highly strained systems should be assembled and operated only by personnel who have been trained in proper safety practices.

WARNING: NOT EXPLOSION PROOF!

Installation of this instrument in an area requiring devices rated as intrinsically safe is not recommended.

WARNING: VOLTAGE SUPPLY!

Use only the wall plug-in power supply delivered with your PicoSens and verifies that the input voltage and frequency are compatible with the power outlet.

Table of content

1. MultiSens Operating Principle

The MultiSens is a fiber-optic white light interferometric multi-channel signal conditioner having the capability of accurately measuring the absolute path length difference of various type of sensing interferometers. Opsens produces a variety of interferometric sensors that are based on either so-called Fabry-Perot interferometer (low-finesse version) configuration or on the polarization interferometer configuration. For example, Opsens temperature sensors are based on a polarization sensing interferometer using the temperature-dependent optical properties of a birefringent crystal while Opsens pressure, strain and displacement sensors are based on a Fabry-Perot sensing interferometer where the distance between the two mirrors of the interferometer varies as a function of the measured parameter. In all cases, the sensing interferometer is made so its path length difference varies with the physical parameter of interest. The path length difference of the sensing interferometer is accurately measured with a nanometer resolution and this over 30 000 nanometers range.

Physical measurements are possible if the path length difference of the sensing interferometer is a univocal function of the parameter under scrutiny. This being the case with Opsens sensors, the MultiSens must know the relation between the path length difference and the physical parameter. The Gauge Factors, or equivalently the calibration factors, that comes with Opsens sensor contain all the information needed by the MultiSens to perform the conversion from the measurement of the path length difference to the physical value being measured.

For readers that may need to have a better understanding of the operating principle of the MultiSens, we refer to the white paper IMP0002 entitled “Opsens White Light Polarization Interferometry Technology” available on Opsens’ web site: http://www.opsens.com/pdf/WLPI.pdf.

2. Quick start

2.1 Power supply

The MultiSens accepts supply voltage form 12 to 30 Vdc. The supply connection is made through the round 2.1 mm power jack (outside ground, inside positive) located on the back panel (Figure 1). You can use either the included 12V wall-mount power supply or use another power-supply.

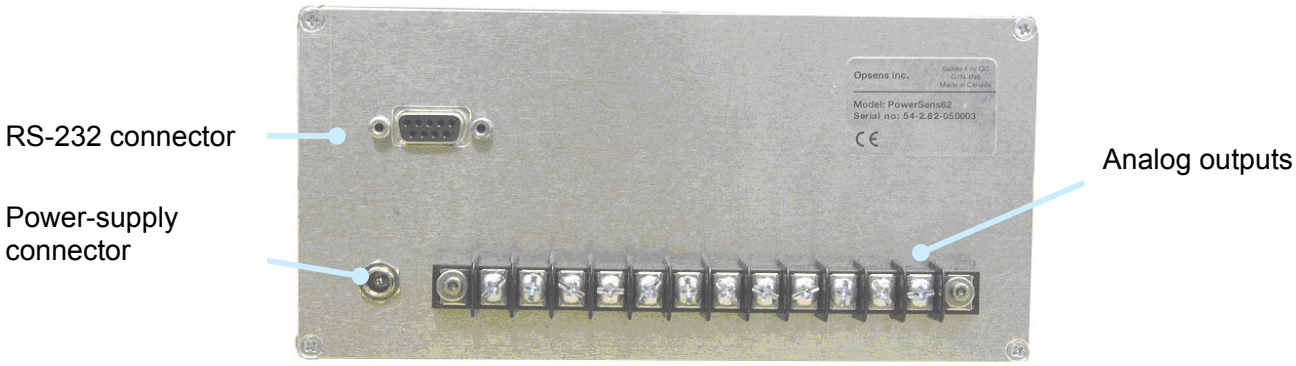


Figure 1 : MultiSens backpanel

2.2 Sensor connection

Opsens fiber-optic sensors or transducers must me mated to the MultiSens output connectors (Figure 2). The optical connectors provided with the MultiSens is usually a square push-pull SC-type connector mounted with a SC-SC type mating. Remove the protective cap of the mating, engage the sensor connector with the orientation key properly oriented and push until it clicks into its place. Always clean the sensor connector prior to connect it to the signal conditioner with the included connector cleaner. Use a fresh section of cleaning cloth every time. Ask for Opsens Fiber-Optic Cleaning Guide for further information on how to clean fiber-optic connectors.

NOTE: Always clean the connector ferrule end face with the include connector cleaner before each connection. Failure to do so can result in permanent damage to the connector caused by hard particles trapped between the fiber optic end faces.

NOTE: Always replace the protective dust cap on the mating when there is no sensor connected and always replace the protective dust cap on the sensor fiber-optic connector when not in used.

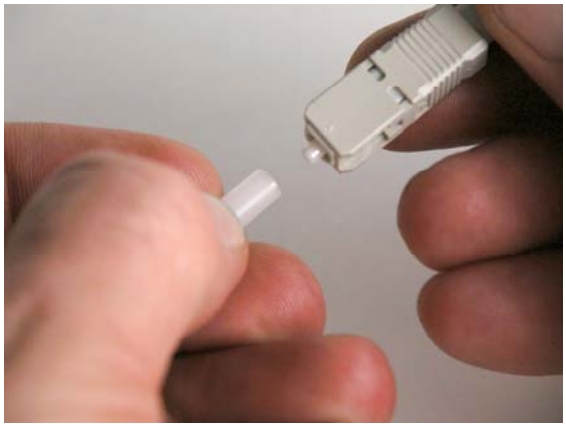


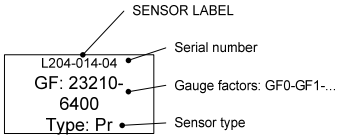
Figure 2 : Remove the protective cap before connecting

Figure 3 : Always clean the end of the connector ferrule before each connection

Figure 4 : Engage the sensor connector with the orientation key properly oriented and push until it clicks into place

Figure 5 : To disconnect, grab the square connector body and just pull

2.3 MultiSens setup



The MultiSens is compatible with all Opsens' WLPI type sensors or transducers for measuring various parameters such as temperature, pressure, strain and displacement. (Note that the GaAs type PowerTemp temperature sensors are compatible with either the PowerSens or the PicoPowerSens signal conditioners only). To properly use a specific sensor, its corresponding Sensor Type and Gauge Factor(s) must be entered into the MultiSens non-volatile memory (Sensor definition) and then the defined sensor must be selected (Sensor selection) on the specific channel. These numbers contain the parameterization factors of the sensor that is the sensor type and the sensor calibration parameters. These factors are indicated on a label fixed on the optical cable of the sensor, nearby the optical connector as indicated on the left figure. The label shows the identification number of the sensor (used for record purpose only), the Gauge Factors GF0, GF1, …, and the Sensor Type.

The type of the sensors depends of the physical parameter to be measured. For example, the T-type (T1, T2, etc) are used for defining temperature sensors, the P-type (P1, P2, Pv, etc) are used for defining pressure sensors and the S-type are used for defining strain sensors. There are also special type definitions that are the N-type and the X-type, which are not related to any specific sensor. These are needed for internal calibration purpose only and should be not used unless instructions have been given by Opsens to do so.

2.3.1 Define a sensor

Before selecting a specific sensor, it must be defined that is its corresponding Sensor Type and Gauge Factor must be stored into the non-volatile memory of the instrument. The following example shows how to define a Pr type pressure sensor.

DEF	Enter Define Sensor Menu	Def Probe >Type T1
↑ ↑ . . .	Select Sensor Type; use up or down arrow keys	Def Probe >Type Pr
√ √	Press (√) key to accept the type and (√) key again to edit the name of the sensor	Def Probe >Nam Pr00 OK GF1 31000 GF2 0000
↑ ↓ √	Use Default Name or select a name for the sensor using up or down arrow keys (00 to 99 numbers only)	Def Probe >Nam Pr00 OK GF1 31000 GF2 0000
↓ √ ↑ … √	Enter Gauge Factor GF1; use arrow keys and validate the entry with the confirm (√) key	Def Probe Nam Pr00 OK >GF1 23210 GF2 0000
→ √ ↑ … √	Repeat above procedure if other GF are required	Def Probe Nam Pr00 OK GF1 23210 GF2 6400
↑ √	Select "OK" and press the confirm (√) key	Def Probe Nam Pr00 >OK GF1 23210 GF2 6400
MENU MENU	Quit the menu	

2.3.2 Select a sensor among previously defined sensors

Once a sensor is defined, it can be selected for a specific channel as indicated below (example for selecting in channel 2).

SEL	Enter Sensor Select Menu	1>= None 2 = None 3 = None 4 = None
↓ √	Select a channel using the direction arrows and then the confirm (√) key	1 = None 2 =>None 3 = None 4 = None
↑ √	Select sensor using the up/down arrows	1 = None 2>= Pr00 3 = None 4 = None
MENU MENU MENU	Quit the menu	

2.3.3 Zeroing a sensor (when required)

If required, zeroing a sensor is easily done with the NULL button (example for selecting in channel 2).

	From the measurement display screen, press the confirm (√) key	1> 14.6psi 2 14.3psi 3 14.8psi 4 14.4psi
	Select a channel using the direction arrows and then the confirm (√) key	1 14.6psi 2> 14.3psi 3 14.8psi 4 14.4psi
	Press the NULL button and the reading from that channel is zeroed	1 14.6psi 2> 0.0psi 3 14.8psi 4 14.4psi

NOTE: Without a sensor connected, the MultiSens shows the message "NoS" or "No Signal" on its display.

2.4 MultiSens remote connection and control

The MultiSens comes with a RS-232 serial communication port. The MultiSens is remotely controlled by having a computer linked to this serial port and using the SoftSens software provided with the signal conditioner.

With RS-232 serial communication, simply connect a standard serial cable (all wires straight through) to the MultiSens DB-9 connector and to a remote computer. Then open SoftSens software as indicated in SoftSens user manual.

2.5 Analog output

Sensor readings are available for each channel at the analog output terminals, located on the backpanel of the instrument. See section 3.4.3 for configuring the offset and scaling of the voltage output. Figure 6 shows the terminal assignments for the analog output.

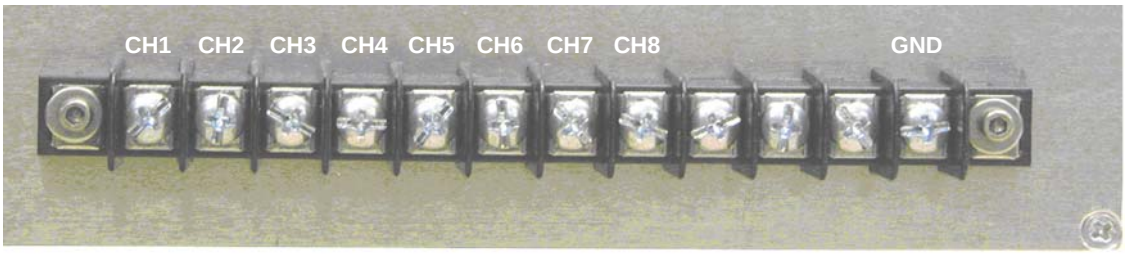


Figure 6 : Analog output terminals assignment

3. Local Operation

3.1 Keyboard

3.1.1 Switch on/off

The instrument is switched on/off with this button.

3.1.2 Menu Button

Menu button gives access to the system menus. Once in the menu, this button brings the user one level higher into the menu hierarchy. Once at the root, the system will exit the menu and goes back to measurement display.

3.1.3 Left/Right Arrows

Left/Right arrows allows navigating 1) within the Gauge Factors of a given sensor being defined, selected, modified or deleted, or 2) it allows moving from one digit to the other when a value is being entered.

3.1.4 Up/Down Arrows

Up/Down arrows allows navigating 1) between menu items of a given hierarchical level, or 2) it allows changing a value being entered.

3.1.5 Confirmation button

Confirmation button permits confirming 1) a new value being entered, 2) confirm the selection of a menu item then moving one hierarchical level lower, 3) refreshing displayed value in the case of diagnostic.

3.1.6 Scan Button

Pressing this button stop the scanning measurement over all channels and reads only a single channel at full speed. The user can select the channel by using the up/down/left/right arrows. Pressing the SCAN button once again resumes to the scanning of all enabled channels.

3.1.7 Define Button

This button is a shortcut that brings the user directly to the menu item for defining the Gauge Factor of a new sensor.

3.1.8 Select Button

This button is a shortcut that brings the user directly to the menu item for selecting a new sensor being used.

3.1.9 Null Button

This button allows to cancel most operations taking place, and return directly to the measurement display. This button is also used for zeroing a sensor when the system is not within the menu (measurement display mode).

3.2 Main Menu

When the Menu button is pressed, the display shows the following submenus :

- Probes
- Setting
- Diagnostic

The Probes submenu is used to define, select, modify and delete sensor definitions in the sensor list.

The Setting submenu is used to modify the general system settings such as averaging mode and analog output configuration.

The Diagnostic submenu is used the display some quality indicators on the optical signal from each channel. This is useful for troubleshooting purpose.

3.3 Probes Submenu

The Probes submenu is where all sensor-related commands are made.

3.3.1 Def Probe

This command is used to define the parameters for a new sensor. It has been described in section 2.3.1.

3.3.2 Sel Probe

This command is used to select a sensor for each channel. It has been described in section 2.3.2.

3.3.3 Mod Probe

This command is used to modify the parameters for a sensor that has been already defined. It works basically the same way as the Def Probe function described in section 2.3.2.

3.3.4 Del Probe

This command is used to delete a sensor from the sensor list. Select the sensor name to delete with the up/down arrows and pressing the confirm (√) key.

3.4 Setting Submenu

The functions below are used to setup specific parameters of the instrument. Some of the settings are not necessary related to a specific sensor.

3.4.1 Channels

This function is used to enable (ON) of disable (OFF) some or all channels. Use the up/down arrow to select the channel, press the (√) key, use the up/down arrow to select OO or OFF and press the (√) key again.

3.4.2 Average

The user can set ON or OFF the averaging mode (ON by default). When on, the measurements either displayed on the front panel display, output on the analog output or on the RS-232 port is the result of the average of 5 sequential measurements.

This parameter is not saved and is lost when the system is switched off.

3.4.3 Analog output

The analog output parameters comprise the scale factor and the offset. The scale factor corresponds to the physical unit per Volt (unit/V) output, while the offset corresponds to the physical value at which the user wants the analog output to be at zero volt. For example, one may desire to have 10 ^{o}C/V, being offset at 5 ^{o}C. The analog output voltage is thus given by:

Temperature = [Voltage output] x 10 °C/V + 5 °C.

To change the analog scale and offset for a specific channel, first select the proper channel with the up and down buttons, then press the confirmation button. Then navigate between the Scale and Offset values, again with the up, down and confirmation buttons.

Any new scale factor is saved in the non-volatile memory. This value is used whenever the system is switched on and off.

By default, the offset value is 0. A new offset value is not saved and it is lost when the system is switched off, or when the sensor is de-selected.

3.4.4 Units

The user can choose what are the units displayed for each given type of sensor. For example, temperature sensors (type T1, Tm and Tq) can have their measurements displayed in either Celsius or Fahrenheit. This choice affects the values on the display, on the analog output as well as the values sent by the serial port.

Note that when the units are changed, the analog output scale usually needs to be adjusted.

For almost all sensor types, the user can select between two kinds of physical units for outputting the data readings as indicated in the following table.

Sensor type		**Physical units**	
T1	Standard Temperature	Celsius (°C)	Fahrenheit (°F)
Tm	Medical Temperature	Celsius (°C)	Fahrenheit (°F)
Pm	Medical Pressure	mmHg	
P1	Absolute Linear Pressure	bar	psi
P2	Relative Linear Pressure	bar	psi
Pv	Absolute Linear Pressure (vacuum)	mbar	torr
S1	Strain	micro-strain: µm/µm or µin/µin (µε)	
D1	Displacement	mm	inch

NOTE: changing the kind of physical units of a specific sensor type will affect all the defined sensors of that type.

3.4.5 Special

This submenu contains two special functions : “Unit Mode” and “No Signal”.

The “unit mode” setting overrides the display in physical units and gives a reading of the “optical path difference” of the sensors instead. This is a specialized command that should be used only when properly instructed by Opsens personnel.

There are certain circumstances (i.e. some remote control programs) where it is not desirable to display a No Signal when a sensor is unconnected or defective. Hence, the “No Signal” message can be enabled or disabled. This choice affects the values on the display, on the analog output as well as the values sent by the serial port.

Both these settings are not saved and are lost when the system is switched off.

3.5 Diagnostic Submenu

The user can look through a variety of internal parameters for each optical channel. This can be used to diagnostic potential problems with the system or a specific sensor. Typical diagnostic parameters are shown below. Diagnostic values can be refreshed by pressing the confirmation button  . The channel number can be changed with the up  and down  buttons.

Parameters		Description
Lg	2.6V(volt)	Light level
Ga	1.3(no unit)	Amplifier gain
Lm	47% (%)	Lamp driving level
Ct	18 %(%)	Signal contrast
SNR	485(no unit)	Signal quality

The following table shows diagnostic values with good signal, poor signal, or with a broken sensor (“fault”). A fault condition results in a “No Signal” being displayed.

Parameter	Good signal	Poor Signal	Fault
Lg	> 2.2	< 2.2	—
Ga	< 2.0	> 2.0	—
Lm	< 90 %	> 90 %	—
Ct	> 15 %	< 15 %	—
SNR	> 200	< 200	< 100

NOTE: Without a sensor connected, the instrument shows the message “NoS” or “No Signal” on its display.

In the unlikely situation that this message appears while a sensor is connected to the unit, take note of the diagnostic parameters and contact Opsens technical support.

During a No Signal condition, the analog output and the serial ports output constant values as follow:

Output	No Signal condition output value
Analog	0 Volt
RS-232	65 536.0

4. Remote operation

Opsens MultiSens signal conditioner comes with a RS-232 serial communication interfaces to allow control with a remote computer. The RS-232 interface settings are indicated on the following figure.

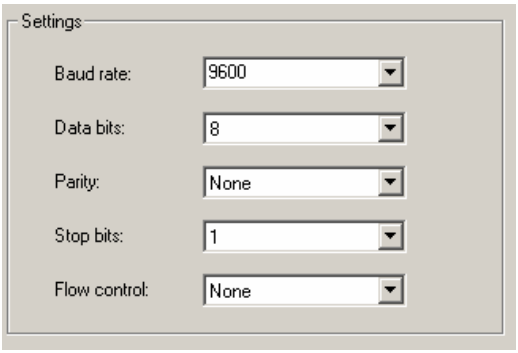


Figure 12: RS-232 interface setting

The serial interface remote control commands are based on the standard SCPI syntax (**S**tandard **C**ommands for **P**rogrammable **I**nstrumentation). The user can create its own remote control software using the various SCPI commands available for the MultiSens. But for ease of operation, Opsens provides its own control software, called SoftSens, which gives access to all the functionalities of the instrument. See SoftSens user manual for how to remotely control the MultiSens conditioner.

For those who which to develop their own remote control software, ask for Opsens Serial communication user manual to get all the information about serial interfacing with Opsens signal conditioners.